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The vagueness of “biodiversity” and its implications in conservation practice

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Abstract: The vagueness of the notion of biodiversity is discussed in the philosophical literature but most ecologists admit that it is unproblematic in practice. We analyze a series of case studies to argue that this denial of the importance of clarifying the definition of biodiversity has worrying implications in practice, at three levels: it can impair the coordination of conservation actions, hide the need to improve management knowledge and cover up incompatibilities between disciplinary assumptions. This is because the formal agreement on the term “biodiversity” can hide profound disagreements on the nature of conservation issues. We then explore avenues to unlock this situation, using the literature in decision analysis. Decision analysts claim that decision-makers requesting decision-support often do not precisely know for what problem they request support. Clarifying a better formulation, eliminating vagueness, is therefore a critical step for decision analysis. We explain how this logic can be implemented in our case studies and similar situations, where various interacting actors face complex, multifaceted problems that they have to solve collectively. To sum up, although “biodiversity” has long been considered a flagship to galvanize conservation action, the vagueness of the term actually complicates this perennial task of conservation practitioners. As conservation scientists, we have a duty to stop promoting a term whose vagueness impairs conservation practice. This approach allows introducing a dynamic definition of “biodiversity practices”, designed to play the integrating role that the term “biodiversity” cannot achieve, due to the ambiguity of its general definition.

DOI: https://doi.org/10.1007/978-3-030-10991-2_17

Posted at the Zurich Open Repository and Archive, University of Zurich

ZORA URL: <https://doi.org/10.5167/uzh-180653>

Book Section

Published Version



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Originally published at:

Meinard, Yves; Coq, Sylvain; Schmid, Bernhard (2019). The vagueness of “biodiversity” and its implications in conservation practice. In: Casetta, Elena; Marques da Silva, Jorge; Vecchi, Davide. From assessing to conserving biodiversity. Cham: Springer, 353-374.

DOI: https://doi.org/10.1007/978-3-030-10991-2_17

Chapter 17

The Vagueness of “Biodiversity” and Its Implications in Conservation Practice



Yves Meinard, Sylvain Coq, and Bernhard Schmid

Abstract The vagueness of the notion of biodiversity is discussed in the philosophical literature but most ecologists admit that it is unproblematic in practice. We analyze a series of case studies to argue that this denial of the importance of clarifying the definition of biodiversity has worrying implications in practice, at three levels: it can impair the coordination of conservation actions, hide the need to improve management knowledge and cover up incompatibilities between disciplinary assumptions. This is because the formal agreement on the term “biodiversity” can hide profound disagreements on the nature of conservation issues. We then explore avenues to unlock this situation, using the literature in decision analysis. Decision analysts claim that decision-makers requesting decision-support often do not precisely know for what problem they request support. Clarifying a better formulation, eliminating vagueness, is therefore a critical step for decision analysis. We explain how this logic can be implemented in our case studies and similar situations, where various interacting actors face complex, multifaceted problems that they have to solve collectively. To sum up, although “biodiversity” has long been considered a flagship to galvanize conservation action, the vagueness of the term actually complicates this perennial task of conservation practitioners. As conservation scientists, we have a duty to stop promoting a term whose vagueness impairs conservation practice. This approach allows introducing a dynamic definition of “biodiversity practices”, designed to play the integrating role that the term “biodiversity” cannot achieve, due to the ambiguity of its general definition.

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E. Casetta et al. (eds.), *From Assessing to Conserving Biodiversity*, History, Philosophy and Theory of the Life Sciences 24, https://doi.org/10.1007/978-3-030-10991-2_17

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Keywords Biodiversity · Definition · Conservation practice · Problem solving · Decision analysis

17.1 Introduction

The Convention on Biological Diversity defines biological diversity or biodiversity as “the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part: this includes diversity within species, between species and of ecosystems (United Nations 2013).” This now classical definition is largely discussed in the philosophical literature for being exceedingly vague and in need of clarification (Sarkar 2005; MacLaurin and Sterelny 2008; Meinard et al. 2014; Santana 2014). By contrast, most ecologists consider that this vagueness is unproblematic in practice (Mace et al. 2012).

In this chapter, we argue that this vagueness does have worrying implications in practice, at three levels: it can impair the coordination of conservation actions, hide the need to improve management knowledge and cover up incompatibilities between disciplinary assumptions. Our purview in this chapter is accordingly mainly practical: we aim to address ecologists, conservation biologists and practitioners, with the objective of convincing them that debates on the definition of biodiversity may have concrete implications. The problems that we thereby highlight all stem from the lack of a clear and shared definition of biodiversity. Biodiversity is certainly not the only concept that suffers from being vaguely defined, and in many cases this vagueness does not create much problems. Accordingly, our aim here is not to claim that vagueness is a problem in itself. Our more modest aim is to argue that, in the very specific case of biodiversity, it does have worrying consequences.

Indeed, in this specific case, formal agreements among various actors on the term “biodiversity” can hide profound disagreements on the nature of conservation and ecological issues. This is reminiscent of a classical problem in decision modelling (Bouyssou et al. 2000), for which the proven solution is for interacting actors to articulate a commonly accepted formulation of the key questions structuring their interaction. In line with this view, we propose that, although the notion of biodiversity does not unify biodiversity sciences in a transparent, rigorous way, such a unification may be achieved by clarifying a concept of *biodiversity practices*, understood as coherent collaborative interdisciplinary efforts to tackle commonly identified environmental and conservation problems. We take advantage of insights from the philosophical literature to champion this approach and to argue that, although a definitive definition of these biodiversity practices might be unreachable, the task to constantly improve definitions, taking seriously conservation biologists’ and conservation practitioners’ value-laden stances, is crucial to the enrichment and improvement of conservation theories and practices. If we may paraphrase Burch-Brown and Archer (2017), although we emphasize that one cannot hope to reach a definitive answer to the question “what is biodiversity?”, our approach hence proposes a “defense of biodiversity” that consists in championing a collective effort to

constantly improve our understanding of the value-laden practices gathered under banner of “conserving biodiversity”.

The remainder of this chapter is divided into three parts. In Sect. 17.2, we first show that, despite its being seemingly simple and unequivocal, the definition of “biodiversity” is exceedingly vague. Vagueness in itself is not necessarily a problem. But Sect. 17.3 uses cases studies to show that, in the case of “biodiversity”, this vagueness creates problems in practice. In Sect. 17.4 we then explain our proposed solution. Section 17.5 briefly concludes.

17.2 The False Transparency of the Definition of Biodiversity

The vagueness of definitions of “biodiversity” has been extensively studied in the philosophical literature (Sarkar 2005; MacLaurin and Sterelny 2008; Meinard et al. 2014), but for lack of a concrete understanding of its implications for conservation science and practices, this debate has been largely confined to philosophical discussions without affecting real-life conservation and ecological practices (for a noticeable exception, see Delong 1996). Let us first explain why we claim that definitions of “biodiversity” are vague.

17.2.1 Diverging Definitions of “Biodiversity” Coexist

A first example will illustrate how deceptive is the idea that the definition of “biodiversity” is clear and unequivocal. Let us look at two prominent approaches to biodiversity, articulated by a leading author in conservation biology and a leading author in ecosystem ecology: Sarkar (2005) and Loreau (2010).

Loreau (2010) does not delve into definitional debates. He uses a definition very similar to the one of the CBD, stating that “biodiversity [...] includes all aspects of the diversity of life—including molecules, genes, behaviors, functions, species, interactions, and ecosystems” (p. 56). The fact that he uses such a sketchy definition suggests that he takes the definition to be unproblematic and consensual. By contrast, Sarkar (2005) explicitly tackles the definitional issue. Following MacLaurin and Sterelny (2008, p. 8), one can summarize his approach by stating that, according to his definition, “‘biodiversity’ [means] whatever we think is valuable about a biological system” (MacLaurin and Sterelny’s interpretation of Sarkar’s theory can be criticized, but for the purpose of the present chapter, we will not delve into this exegetic debate).

A striking difference between Loreau’s (2010) and Sarkar’s (2005) definitions is that, whereas Sarkar’s definition explicitly mentions values, Loreau’s definition exclusively mentions purely biological concepts and objects. Despite this major difference, Sarkar explicitly claims that he use the concept of biodiversity in an uncontroversial and widely shared sense: he even writes that his approach captures the

“consensus view” (p. 145). And Loreau makes the same claim, though implicitly, since he admits that there is no need to delve into definitional issues. Despite the major difference between their respective definitions, both authors hence claim that their approach captures the general understanding of the concept.

Hence, although Loreau (2010) and Sarkar (2005) use the same term and take for granted that they understand it in the same way as everyone else, they actually understand it markedly differently. Can this kind of misunderstanding have practical implications? In the sections to follow, we argue that, in the case of biodiversity, it can.

17.2.2 The Various Disciplinary Studies “of Biodiversity” Do Not Study the Same Things

The literature presenting the numerous measures and indexes of biodiversity is extensive (Muguran and McGill 2011). It is commonplace to notice that the different disciplines (encompassing what will thereafter be termed various “biodiversity studies”) respectively favor different indexes because they capture concepts that are better adapted to their subject-matter. The term “biodiversity” is used in articles from these various disciplines mostly in introductions and conclusions, whereas discipline-specific concepts such as species richness (Fleishman et al. 2006), phylogenetic distances (Faith 1992) or functional traits or attributes (Petchey and Gaston 2002; Mason et al. 2003) replace it in the methods and results sections (Meinard 2011). Similarly, environmental economists often use the term “biodiversity” to introduce and justify their research, but rapidly switch to disciplinary concepts, such as “naturalness” (Eichner and Tschirhart 2007) or “perceived diversity” (Moran 1994). The same is true of the other disciplines concerned with biodiversity. Accordingly, although they all claim to study biodiversity, the various biodiversity studies actually produce results that account for different objects, properties and processes (Maclaurin and Sterelny 2008).

The concept of biodiversity itself is never used in articulating results, in any of these disciplines. It is mostly confined to introductions and conclusions, where it plays the role of a catchword.

17.2.3 The Various Disciplinary Studies “of Biodiversity” Presuppose that they Study Various Aspects of a Common Entity

By using the notion of biodiversity in their introductions and conclusions, all these heterogeneous studies presuppose, at least implicitly, that the various objects, properties and processes that they study are aspects of a common entity: biodiversity

(here we use the term “entity” in a purportedly very large sense, encompassing all sorts of ontological units, such as objects, properties, natural kinds, and so on). They do not claim that their concepts or measures represent all of biodiversity, but that there is a common entity, biodiversity, which is partially captured by their favorite measures and concepts.

In the current literature on biodiversity, the various studies simply state that their subject-matter is an aspect of the putative entity biodiversity, without explaining what this entity is supposed to be. What is this putative common entity supposed to be?

17.2.4 Defining “Biodiversity” Thanks to the Notions of Diversity or Variety Is Insufficient to Identify such a Common Entity

The literature on indexes and measures of biodiversity is notably vague on the issue of a proper identification of this common putative entity—biodiversity. The usual explanation identifies it as a specification of a more general entity: the property diversity (Maris 2010). Biodiversity would be the diversity of living things (Gaston and Spicer 2004), along genetic, phylogenetic and functional dimensions (Purvis and Hector 2000).

This approach bears some seeming credibility because “diversity”, and synonyms in ordinary language such as “variety”, belong to the everyday language and thus seem clear and self-evident. Intuitively, diversity is a property characterizing groups of individuals, depending on the number of individuals and on their similarities and dissimilarities. But the precise roles of numbers, similarities and dissimilarities, and the metrics used to measure them, are not elucidated at this intuitive level.

To determine whether “diversity” truly captures a coherent notion, axiomatic studies have tried to formalize the properties associated with it (Weitzman 1992; Nehring and Puppe 2002). They thereby showed that these properties are highly variable and that the notion of diversity is accordingly deeply ambiguous (Gravel 2008) (in other words, what these studies show is that, whereas it seems self-evident at first sight that diversity is a property, in fact the term “diversity” captures different sets of properties in different contexts, which makes it questionable to claim that “diversity” refers to a property properly speaking). The terms “diversity” or “variety” thus function like a term such as “adaptation”. “Adaptation” has different meanings in various subfields of evolutionary biology, it has a markedly different meaning in medical physiology, and yet other meanings in ordinary language. The same holds true for “diversity” and “variety”. Within disciplines or, more precisely, within subfields, these terms are relatively unambiguous and generally well-defined, but their meaning varies between disciplines or subfields. As a consequence, these terms cannot be unambiguously used in both ways at the same time. Either one relies on subfield-specific, technical and well-clarified definitions of the terms “diversity”, “variety”, etc.—but in that case one can no longer draw upon the self-

evidence of these terms in everyday language. Or one relies on everyday language—but in that case, one has to face the fact that ordinary language does not delineate coherent notions of diversity or variety. In both cases, using the terms “diversity” or “variety” in a general definition of biodiversity is problematic, because one cannot take for granted that others will understand the notion in the intended way. Therefore, if buttressed on general terms like “diversity” or “variety”, a general definition of biodiversity does not single out a unique entity, and is therefore useless to support the idea that “biodiversity” refers to a common entity.

Here again, the comparison with “adaptation” is illustrative. A rigorous evolutionary biologist would never use the term “adaptation” when talking to lay people or to physiologists without specifying that his technical understanding of the term is very specific. The evolutionary biologist knows that his interlocutors think that they understand the term “adaptation”, and he knows also that, in a sense, they are right to think that they understand the term. But he also knows that they understand the term in another sense, rather than the one he has in mind. Therefore, it is natural for him to clarify the meaning of the term. This crucial step is the one that is missing in the case of “biodiversity”.

The theoretical considerations developed in this Sect. 17.2 may appear purely formal, without implications for concrete conservation science and action. The goal of the following section is to demonstrate that the reverse is true.

17.3 How False Transparency Creates Concrete Problems for Conservation Science and Action

In order to explain the concrete problems created by the seemingly purely theoretical reasoning spelled out in Sect. 17.2, let us now take three concrete case studies, each illustrating a specific kind of problem.

17.3.1 *The False Transparency of “Biodiversity” Can Impair the Coordination of Interacting Conservation Actions*

Misunderstandings created by the false transparency of “biodiversity” can have detrimental implications at the level of practical conservation management, as can be illustrated by the story of the management of the Bel-Air valley in South-west France (Gereco, unpublished report 2014). This is a small valley (Fig. 17.1) containing a rich mosaic of aquatic and humid habitats in a karstic system close to semi-arid grasslands and upstream water meadows (surrounding the Charente River).

This valley shelters a population of otters (*Lutra lutra*) and a massive population of Louisiana crayfish (*Procambarus clarkia*). The latter is an invasive species having major detrimental impacts on the functioning of aquatic ecosystems (Angeler



Fig. 17.1 The Bel-Air valley

et al. 2001; Rodriguez et al. 2005). However, its impact on Mammals populations is modestly positive (Correia 2001), and from the point of view of otter-watchers it has the advantage to turn otters' spraints into red, greatly facilitating the observation and monitoring of otter populations. The above report also unveiled the presence of Japanese knotweed (*Reynoutria japonica* Houtt., 1777), an invasive plant with deeply damaging impacts on wetland ecosystems.

The valley is managed by an environmental association, Perennis. The downstream water meadows are protected under the Habitat Directive (HD, a cornerstone of the European Union policy to maintain biodiversity: European Commission 1992) and are accordingly managed by another environmental association, the Birds Protection League (“LPO”). Both actors act according to management schemes explicitly aimed at conserving “biodiversity”.

But on closer examination, it appears that Perennis understands “biodiversity” in a Sarkar-like manner. Indeed, as amateur naturalists, they value first and foremost the emblematic otters: for them promoting biodiversity mainly means managing the otter population. Because crayfish makes it easier to observe otter, and because they have not witnessed any impact of knotweed on otters yet, they do not see invasive species as a prominent topic in their agenda to conserve “biodiversity”. By contrast, directed as it is by European guidelines applicable to the entire Natura 2000 network, the LPO has to conceive of its objective to preserve biodiversity in a way that puts more emphasis on ecological functioning. In particular, following the guidelines spelled out in Evans and Arvella (2011), its management actions have to actively tackle the problems created by invasive species populations. Accordingly, for the LPO, conserving biodiversity in this area implies managing the crayfish and knotweed populations (or at least it implies a need to carve out a strategy assessing the kind of invasive mitigation actions that can be performed, and the cogency of implementing them in the light of their cost and likelihood of success).

Perennis’ management strategy aims at “conserving biodiversity”, but this means protecting the otter population, and does not mean tackling the invasive species issue; similarly, the LPO’s strategy aims at “conserving biodiversity”, but this time it means tackling the invasive species issue. Both actors could agree when comparing their objectives: they both strive to “conserve biodiversity.” But if it dismisses the invasive issue when managing the valley, Perennis actually jeopardizes any attempt to tackle this very issue downstream. The formal agreement on “biodiversity” hence hides a deep disagreement on what has concretely to be done.

At this stage, one might retort that misunderstandings like the one sketched above can easily be solved if the actors talk to each other about the concrete actions they want to implement. This is certainly true, and this example is indeed somewhat schematic. Our personal experience however suggests that, in real-life management situations, such seemingly trivial disagreements can persist. This is because the term “biodiversity” provides a common vocabulary that various actors can use to express very different objectives, which can all too easily lead them to fail to see the underlying divergences. In the present work, we obviously do not claim to have quantitatively demonstrated that such problems often arise in concrete conservation situation. Our more modest claim is that it can arise.

17.3.2 The False Transparency of “Biodiversity” Hides the Need to Improve Scientific Knowledge to Solve Complex Management Problems

The case of the Bel-Air valley provided a first illustration of how a concrete management problem can remain unseen because various actors fail to see the need to compare their respective understandings of “biodiversity”. In this case, the problem arises at the level of the interactions between actors implementing conservation

actions. But a deeper problem can arise when innovative solutions and new management knowledge are needed to solve more complex conservation issues. In such cases, the false transparency of “biodiversity” can hide the need to improve scientific knowledge.

An example illustrating this idea is given by the management of so-called “habitats of community interest”, when biological invasion mitigation conflicts with habitat conservation (see Jeanmougin et al. 2016 for a deeper investigation of this conflict). “Habitats of community interest” (HCI) are natural or semi-natural habitats constituting the Natura 2000 network, as application of HD (European Commission 1992). HCI are typically defined in European guidelines (European Commission 2013) and more detailed regional scale manuals (e.g. Bensettiti 2001–2005) by lists of floristic species. For some HCI, these lists contain numerous invasive species (see Jeanmougin et al. 2016, SI-Table 3). For example, this is the case of the HCI “Constantly flowing Mediterranean rivers with *Paspalo-Agrostidion* species and hanging curtains of *Salix* and *Populus alba* (Habitat 3280)”, whose presence has been recently reported in the lower Taravo River area (Corsica, France) (Fig. 17.2) (Gereco, unpublished report 2015).

Eight of the 34 index species of this habitat (*Paspalum distichum* L., 1759, *Paspalum dilatatum* Poir., 1804, *Xanthium strumarium* L., 1753, *Symphyotrichum subulatum* var. *squamatum* (Spreng.) S.D.Sundb., 2004, *Dysphania ambrosioides* (L.) Mosyakin & Clemants, 2002, *Amaranthus retroflexus* L., 1753, *Cyperus eragrostis* Lam., 1791 and *Erigeron canadensis* L., 1753) are considered invasive species according to various European, national or local databases. HD, as a politi-



Fig. 17.2 Paspalo-Agrostidion and curtain of *Salix purpurea* along the Taravo river

cal tool to maintain biodiversity, promotes the maintenance of HCI. On the other hand, the control and eradication of invasive species is also a central objective of many European initiatives to maintain biodiversity, such as the DAISIE (Delivering Alien Invasive Species Inventories in Europe) program and the recent European Directive on Invasive Species (Beninde et al. 2015).

In the case of habitats like HCI 3280, there is an antagonism between the invasive approach and the habitat approach. Indeed, if management actions achieve to mitigate populations of the above-cited invasive species, this will unavoidable imply that the area identifiable as HCI 3280 will decrease. Conversely, if management actions achieve an increase of the area occupied by HCI 3280, this will be accompanied by an expansion of populations of the above-cited invasive species. Consequently, elaborating a management scheme in areas like the lower Taravo is problematic, because two actions that are typically considered keystones of any biodiversity conservation strategy (invasive species mitigation and habitat conservation) are antagonist in such cases.

However, there is no scientific study or publication tackling this question (see Jeanmougin et al. 2016 for a bibliographic exploration quantitatively corroborating this idea). According to the database (ETC-BD 2015) constructed as part of the European-wide evaluation of the conservation status of HCI (European Union 2015), this habitat is present in no less than five countries in Europe (France, Greece, Italy, Spain and Portugal). Management schemes are hence devised and implemented all year long in the whole European Mediterranean region to manage this HCI, but there is no scientific guideline to decide how to solve the contradiction between the objectives to mitigate biological invasion and to promote the conservation status of habitat 3280.

Like most complex problems at the science-policy interface, this specific problem certainly has multifarious origins, having to do with the complex challenges in (1) translating ecological theory into practice (Knight et al. 2008), (2) defining the relevant expertise (Burgman et al. 2011), (3) choosing the relevant scientific paradigms to ensure operationality (Jeanmougin et al. 2016), (4) drawing the line between scientific information and advocacy (Brussard and Tull 2007), (5) assessing the proper place of scientific knowledge in the process of policy making (Josanoﬀ 2012) and (6) entrenching the importance of an open diffusion of information on conservation practices (Meinard 2017a). We do not claim here to do justice to all these aspects, their interrelations and their relative importance in the genesis of problems such as the one of the above introduced lack of knowledge on HCI 3280 management and invasive species. Our more modest purpose is the following. We want to show that, by granting a key-role in the coordination between disciplinary approaches to a vague term like “biodiversity”, one tends in all likelihood to render invisible the kind of knowledge gap at issue in our example. We accordingly do not claim to unfold a scientific demonstration here, but rather to hypothesize a possible mechanism that occurred to us thanks to our own field experience.

We propose that this mechanism is simply that specialists of invasive species stress the importance of controlling invasive species and present such a control as a prominent means to maintain biodiversity. But as non-specialists of habitats, they

simply accept what specialists say about the self-evidence that maintaining HCI is also unquestionably good for biodiversity. Specialists of habitats behave in a symmetric way. Everyone thus agrees with the overarching objective to maintain biodiversity, everyone is careful not to question the expertise of one’s interlocutor, and no one sees the need to improve knowledge and to carve out innovative management solutions in complex cases such as the one of habitat 3280.

As a consequence in the field, at the end of the story the resulting management scheme is most of the time decided more or less arbitrarily by political decision-makers or consultants on the basis of political, economic or circumstantial considerations. In the case of the Taravo River, the management scheme produced in 2014 (Lindenia, unpublished report 2015) does not mention this problem.

17.3.3 The False Transparency of “Biodiversity” Hides that Various Approaches Are Based on Incompatible Postulates

A more subtle, but no less important problem arises when interactions with non-ecological disciplines are involved. Let us start by illustrating the problem with an example: Eichner and Tschirhart (2007)’s ecological-economic study of a fishery ecosystem. Their aim is to establish how to organize fisheries given that the exploitation of a given species can have complex repercussions on the broader ecosystem. In their study system, human consumers buy items of one species (Pollock, *Theragra chalcogramma*) on markets and thereby indirectly impact other species due to between-species interactions in the ecosystem. This indirect impact then alters the provision of various ecological services. For example, the sheltering function of kelp (*Laminaria* spp.) can be altered, which has an impact on the populations of Pacific halibut (*Hippoglossus stenolepis*) and Pink salmon (*Oncorhynchus gorbuscha*), which in turn alters the so-called “consumption services” (MEA 2005) for consumers of the latter species.

Eichner and Tschirhart (2007)’s solution is that if taxes on harvesting activities or caps on harvest, calibrated thanks to a precise knowledge of the functioning of the ecosystem, are implemented, demand will drop, overfishing will cease, kelp will recover, etc., and consumers will end-up being more satisfied.

The economists who authored this study claim that they provide insights that are complementary to those provided by ecologists to resolve a commonly identified problem—the problem of how to manage a complex ecological-economic system. Unfortunately, the way they see this problem is strikingly different from the way many ecologists see it. The compatibility of their prescriptions with prescriptions stemming from biological studies can accordingly become problematic.

Indeed, Eichner and Tschirhart (2007)’s understanding of the problem is based on a moral assumption—that is, an assumption about what is morally legitimate for scientists to do. They assume that consumers’ preferences are given, and that the

results of their study should not lead to a modification of consumers' preferences. Consequently, they do not integrate in their models the fact that being aware of the ecological impact of their act may change the behavior of the consumers. In technical economic terms, this assumption is encapsulated by the fact that human behavior is modeled using a predetermined utility function (Orléan 2011), whose parameters are not fed-back by the results of the study. Consumers are assumed to behave as if they were maximizing a function whose arguments are prices and quantities of goods they buy on markets. The knowledge of the system does not appear in the function: when a given consumer learns to know that his buying Pollock has impacts on populations of Salmon, this does not make any difference in his behavior on the Pollock market.

Such predetermined utility functions are often presented, like many other economic modelling tools, as morally neutral tools providing empirical complements to moral discussion (e.g. Scharks and Masuda 2016). When presented like this, it seems that predetermined utility function, as well as other modelling tools widely used in ecological-economic studies, can be used in conservation initiatives without interfering with the ethical motivations underlying the latter. Following the same logic, when an ecosystem ecologist works on a specific ecosystem process and an economist computes the economic value of an ecosystem service based on this process, it might look as though the two can work together and the end-result of their conjoint work is no less ethically neutral than the original ecological study of the ecological process. This repeatedly rehearsed logic is, however, largely acknowledged to be flawed: predetermined utility functions are not morally neutral modeling tools (Sen 2002; Hausman and McPherson 2006; Meinard et al. 2016). Using these tools means assuming that the results of the study should not lead to a modification of consumers' preferences: if consumers prefer *x* to *y*, the study should never aim at modifying this fact. This is not a technical constraint: implementing a feed-back between the results of the model and preferences is not technically difficult (Lesourne et al. 2006). It is a moral stance: using predetermined utility functions is a means to promote the anti-paternalistic attitude to leave preferences as they are (Kolm 2005; Sagoff 2008) and to advocate that the satisfaction of preferences as they are is an acceptable, or even desirable, objective (Sagoff 2008).

This moral stance might seem reasonable enough—why should the economist think that he knows better than the consumer what the latter should prefer? But this moral stance can be problematic from the point of view of conservation sciences, because convincing people that their preferences are ill-conceived is a prominent means to achieve conservation targets. Many applied ecological studies are even openly based on moral assumptions that are diametrically opposed to the above one. Take for example the adaptive management approach (Norton 2005), according to which management practices should be seen as experiments from which managers can learn and thereby both improve their knowledge of the managed system and adjust the criteria that they use to evaluate alternative courses of actions (Lee 1993). Contrary to Eichner and Tschirhart (2007)'s model, this approach assumes that people's objectives and preferences are responsive to improvements of their knowl-

edge of the ecological constraints (Maris and Bechet 2010), and that enabling such improvements is precisely one of the motivations to study these systems.

Eichner and Tschirhart (2007)’s solutions are solutions to the problem as they see it, constrained by moral assumptions that are not generally accepted by biologists. This does not mean that their approach is irredeemably irrelevant for biologists, but that using it to identify solutions to the problem as biologists see it requires important reinterpretations and adaptations. Eichner and Tschirhart (2007) however eschew the clarification of this point, and their argument is accepted in the ecological literature without a discussion (as illustrated by its extensive mention in Naeem et al. 2009). It is difficult to see why biologists do not assess the relevance of this model more critically. Our interpretation here is that the false transparency of the notion of biodiversity plays a role in the explanation of the existence of this blind spot. Indeed, this false transparency makes it look as though Eichner and Tschirhart (2007)’s is self-evidently relevant, since it claims to be about biodiversity. We cannot overemphasize that, obviously enough, we do not claim that the term “biodiversity” is the unique, or even the main, culprit in failures of ecological-economic studies of fisheries. The precautions articulated above when analyzing the former case study apply here as well. Our point is more modestly that, by granting a key-role in the coordination between disciplinary approaches to a vague term like “biodiversity”, one tends in all likelihood to render invisible the fact that different disciplinary approaches are anchored in different moral assumptions. Like in our former case study once again, we do not claim to unfold a scientific demonstration here, but rather to hypothesize a possible mechanism, accounting for one possible cause among others behind the shortcomings of the models that we analyze.

Eichner and Tschirhart (2007)’s model is just one example, but it is a paradigmatic one, for two reasons.

First, the moral assumption mentioned above is so entrenched in the economic literature that some authors (e.g. Orléan 2011) use it to characterize the vast majority of the current economic literature. This does not mean that economic studies necessarily make this assumption, since heterodox approaches reject it (Lesourne et al. 2006), but rather that this assumption is bound to create recurrent problems in economics/ecology interactions.

Second, the problem witnessed in our example between ecology and economics exists between ecology and other disciplines. For example, numerous anthropological studies presenting themselves as studies of biodiversity acknowledge that they are based on moral postulates (e.g. Mougenot 2003). But if ecologists and anthropologists do not investigate whether their respective moral assumptions are compatible, the possibility for them to provide coherent prescriptions for action is unwarranted.

To sum up the lesson from this third case study: when various disciplines present themselves as studies of different aspects of a common object—biodiversity—they tend to ignore that, if they are based on incompatible moral assumptions—as they often are—the very meaning and usefulness of their interactions are questionable.

17.4 The Way Forward

In the former section, we explored various concrete examples that allowed us to illustrate different kinds of problems created by the false transparency of “biodiversity”. The order of presentation was one of increasing complexity and increasing explanatory content: the first example was a simple case of diverging conservation objectives, the second one involved a more interpretative analysis, and the last one eventually allowed us to articulate the crux of the problem created by the false transparency of “biodiversity”: collaborative works or disciplinarily studies that conceive of themselves as tackling different aspects of a common object fail to acknowledge the need to ensure that they tackle different parts of a similarly identified problem. They are caged in an illusory shared ontology of the entity biodiversity.

One might argue that the simple solution to all the problems mentioned above would be to get rid of the term “biodiversity” and stop pretending that the various “biodiversity sciences” have anything in common. Such a radical solution (championed, for example, by Santana 2014) could be counterproductive though, by discouraging interdisciplinary collaboration. This would be at odds with the widely accepted idea that interdisciplinary approaches are needed to tackle the globally pressing environmental challenges (Norton 2002; Loreau 2010b).

The aim of the present section is to delineate possible solutions based on the idea that the need to arrive at commonly identified problems should be taken seriously. We first sketch what such a requirement would concretely mean in the case of our three concrete examples, and then we take a broader view.

17.4.1 *Facing the Issue of Problem Identification*

A leitmotif for contemporary decision analysts, especially those working in multi-actor settings, is that decision-makers requesting decision-support often do not precisely know for what problem they really need support (Bouyssou et al. 2000; Tsoukias et al. 2013). For example, private firms can be aware that they have a problem in their production process because the output is lower than expected. But they don’t know if the problem is that they are inefficient or that they were unrealistic when setting their objectives or that their overall conception of what they aim to do was flawed, etc. They know that they have a problem, but can only articulate a rough, ambiguous formulation of it. More interestingly, various stakeholders, for example involved in the management of a complex system such as a watershed, may have only a very partial understanding of the problem that they are nonetheless in charge of tackling. Clarifying a better formulation of the problem, eliminating ambiguities and vagueness often associated with the terms spontaneously used to request decision support, is accordingly a first, critical step for decision analysis (Belton et al. 1997; Rosenhead 2001). Given the nature of the problems identified in

this chapter, a similar clarification, on a case-by-case basis, of the precise nature of the problem for the resolution of which (often interdisciplinary) interactions are put to use, may substantially improve the situation.

In the case of the Bel-Air valley, instead of resting content with the fact that they both manage their respective areas according to a scheme that mentions the preservation of biodiversity as an overarching aim, the two managers should answer the following questions. "What is the precise nature of the functional links between the Charente water meadows and the habitats of its tributary, the Bel-Air?", "What are the functional consequences of the absence of a control of the crayfish and Japanese knotweed populations in the Bel-Air on the ecological functioning of the nearby water meadows?", "Would it be justified that the manager of the water meadows contribute (through money or workforce) to help the manager of the Bel-Air to implement specific conservation measures?" These are difficult questions, but sweeping them under the carpet by framing the discussions with the vague consensual terms of "biodiversity" does not make them any less urgent.

In the Taravo case, the question "How to manage the river area in such a way as to promote biodiversity?" is meaningless, because, in this case, the two kinds of stakeholders in charge of the site management have distinct concrete objectives and would implement very different and potentially contradictory action. These differences and discrepancies, however, are hidden by the use of the common word "biodiversity". In this case, a clear management policy and scientific knowledge are simply lacking. The very notion that HCI 3280 is protected under European legislation is nonsense so long as there are no scientific answers to the questions: "Is it possible to define this habitat on the basis of other criteria than species lists?" and "Is it possible to preserve this habitat while controlling invasive species at the same time?" These scientific issues are currently not investigated because, mainly due to the fact that problems are formulated in the vague terms of "biodiversity", these genuine, underlying problems do not surface. Similarly, the national and local strategies regularly produced and updated by environmental institutions are of little use if they do not clarify how the various aspects of biodiversity should be ordered when they conflict in a practical management situation. If such a ranking were available, even if scientific studies turned out to demonstrate that it is impossible to define habitat 3280 without referring to invasive species, a management program could be defined for the lower Taravo on an informed, legitimate basis.

Lastly, in the case of economics/ecology interactions, they would gain much transparency if, instead of rehearsing the vulgate of the supposed biodiversity/well-being link, ecology/economics interactions were systematically anchored in a common identification of the answers to the following questions: "For the purpose of a given decision-making on a conservation issue, what kind of economic information is useful?", "Should we take an anti-paternalistic stance like most economists, or should we rather take a more pedagogic stance and admit that ecological knowledge can rightfully be used to improve everyone's decisions?" and "More generally, what kind of prescription for action is legitimate for biodiversity scientists to formulate on the basis of scientific models?"

17.4.2 A Broader View

The above paragraphs might leave the reader somewhat unsatisfied, since we simply spelled out the questions that the actors should ask themselves *in the specific cases we considered*. Isn't it possible to elaborate a more general approach, liable to help solve problems created by the false transparency of "biodiversity" in a more general setting? We believe that it is possible, and here we sketch our proposal.

17.4.2.1 What Do We Need to Define?

A common view, although often implicit, in the literature, is that the definition of the term "biodiversity" has to be an *objectivist definition*. An objectivist definition is a description of the independent, preexisting entity to which the term to be defined refers. For example, an objectivist definition of the term "Mars" is a description enabling to identify the planet to which the term refers—an object independent from and preexisting our specifying that the term "Mars" refers to it. When one claims to define "biodiversity" by specifying preexisting independent objects, properties or processes, one attempts to provide an objectivist definition.

We have argued above that the ambiguity of the current general definition of biodiversity can create damaging problems, but it is unlikely that objectivist definitions can prevent such problems from arising. Our analysis of the case of ecological-economic models rather suggests that, unless it makes an explicit reference to the value-laden aspirations that make sense of the various biodiversity sciences, a definition can hardly be useful to prevent such problems.

We therefore have to carefully examine the reason why we need a definition. We want to make sure that the various approaches gathered under the umbrella of the term "biodiversity" can provide relevant insights to coherently resolve common problems. The term "biodiversity" provides a form of unification between different approaches and disciplines. But this form of unification is defective when it comes to doing justice to this reason, because it covers up misunderstandings between approaches. What we need is another form of unification, liable to prevent such misunderstandings. Our suggestion is that this unification should rather be buttressed on a general definition of *biodiversity practices*, understood as a coherent collaborative effort from various disciplines to tackle commonly identified environmental or conservation problems.

Our suggestion is therefore to shift the focus from the definition of biodiversity conceived as a putative entity to the definition of biodiversity practices, emphasizing the value-laden aspirations underlying them. This suggestion might seem odd at first sight, because it looks as though one needs to have a prior concept of biodiversity in order to talk about "biodiversity practices". Underlying our suggestion is the idea that such a criticism stems from a linguistic illusion. Our language treats "biodiversity" as a substantive, which makes it look as though "biodiversity practices" necessarily are practices towards the entity to which the substantive refers. But we have argued that there is no such entity biodiversity to which "biodiversity" refers.

Whereas our language gives the false impression that one cannot understand what biodiversity practices are without antecedently understanding what biodiversity is, our suggestion is that the reverse is the case: in order to understand what biodiversity is, what we have to do is to start by thinking through what biodiversity practices are (Sarkar’s (2005) approach is very similar to ours in this respect; for an analysis of the differences, see Meinard 2017b).

The search for such a definition of biodiversity practices is bound to be unavoidably largely tentative and interpretative, but it would be misleading to presuppose that this creates a serious problem. The reason is that, when one defines a practice, the suitable definitions cannot be definitive objectivist definitions, because the very act of defining can modify the practice, and this modification can in turn modify the definition. In such a case, the definition does not identify an independent, preexisting practice: it rather participates in the construction of the practice.

The vast literature on the definition of the terms “art” and “artistic practices” perfectly illustrates this idea. Although everybody intuitively knows what these terms mean, there is a vast literature striving to capture definitions of these terms. Unlike biodiversity scientists, art theoreticians have never accepted to rest content with the apparent self-evidence of the central notions of their field: they have endlessly kept trying to find better definitions. It turns out that, in so doing, they have greatly contributed to the enrichment of artistic practices. Indeed, the various definitions of art by prominent art theoreticians have aroused creative responses by artists, who have (more or less consciously) modified their artistic practices to highlight the restrictiveness of these definitions or to explore the avenues they had opened up (Pignocchi 2012).

We argue that, as biodiversity scientists, we should follow this example of art theoreticians. We should always include an explicit definition of the global value-laden biodiversity practices into which we see our studies as being embedded, in such a way as to dissipate misunderstandings like the one highlighted in Sect. 17.3. The point of such references is not just to harbor values, but to prevent misunderstandings. In particular, the value-laden features mentioned in such definitions must be the ones that are crucial to the identification of the general problems that biodiversity sciences should be devoted to solve. If such definitions were systematically formulated, this would launch a creative process by which other biodiversity scientists would modify their practices to criticize the shortcomings or exploit the strengths of each definition, and in turn suggest new definitions, etc.

17.4.2.2 A Tentative Definition

Let us exemplify our approach by articulating our own tentative definition of biodiversity practices:

Biodiversity practices are studies, actions, strategies based on the aspiration that the development and diffusion of ecological knowledge can lead people to improve their course of action by developing responsible, informed and long-term decision strategies and preferences, mindful of the environmental constraints.

This definition is not the result of a grand deductive, philosophical or scientific, reasoning. It is a tentative interpretation of the studies, actions, strategies that our own experience as conservation scientists and practitioners allowed us to experience—and that our case studies above exemplified. This definition is obviously neither definitive nor uncontroversial. In some contexts, it might appear to be too vague and in need of qualifications or discussions, and the emergence of misunderstandings in the future may require reformulations. But as it stands, it is the kind of definition needed to clarify misunderstandings like the one unveiled above.

For example, if Naeem et al. (2009) had started by articulating such a definition, based on the identification of the problems tackled by biologists, they would most probably have faced difficulties to encompass Eichner and Tschirhart (2007)'s model in it, because these authors do not understand the problem of biodiversity management in the same way as most biologists do. Naeem et al. (2009) would accordingly have admitted the necessity to critically scrutinize the relevance of this model for conservation and ecological purposes. A fruitful critical discussion could have ensued and damaging misunderstanding could have been possibly dissipated.

One seeming problem with this approach is that it is likely that the problems tackled by biodiversity sciences will change over time. Encapsulating them in a single definition of biodiversity practices might accordingly risk encouraging immobility. The tentative definition of biodiversity practices just introduced is, however, liable to play a clarifying role without encouraging immobility because it harbors two crucial features. These two features characterize what we will term a “dynamic definition”.

First, since it is granted the status of a tentative definition, it is open to discussion and accordingly flexible enough to continuously adapt to new insights and developments.

Second, since it is meant to be used to critically assess the relevance of various studies for one another, the very act, by a given scientist, to formulate such a definition and test it on a given study can lead him to modify his own practice instead of rejecting the study he assesses. Defining a practice can thereby lead to a modification of this very practice, and this modification can in turn modify the definition.

In this dynamic approach, the best thing that can happen now to the tentative definition of biodiversity practices introduced above is that it be taken seriously enough by biodiversity scientists for them to criticize it, thereby launching the co-evolution of biodiversity practices and their definition.

17.5 Conclusion

The term “biodiversity” is diversely understood by various users, and its general definition is vague. Here we have taken advantage of several case studies to show that this vagueness, which is usually taken by biologists to be innocuous at a theoretical level, can create problems at the concrete level of practical interactions between various approaches to biodiversity issues. The problems studied here share

a common structure. In these various settings, the term “biodiversity” is used by various actors to link their respective approaches. The resulting impermeable division of labor, based on the formal but illusory agreement on the objective to study or conserve “biodiversity”, hides the fact that the various approaches can promote mutually incompatible goals, eventually leading in conservation practice to self-defeating actions. To end such deadlocks, we have claimed that a clarification, on a case-by-case basis, of the precise nature of the problems for the resolution of which interdisciplinary interactions are put to use is a critical step. It can make the various misunderstandings and contradictions currently impeding management practices due to the false transparency of “biodiversity” visible and subsequently help to resolve them. This case-by-case approach then allowed us to develop a more general proposal, delineating a path towards the resolution of problems created by the false transparency of “biodiversity”. The logic of this path can be summed up in four steps:

1. There is need to clarify a general definition of *biodiversity practices*, understood as a coherent collaborative effort from various disciplines to tackle environmental or conservation problems commonly identified on the basis of coherent value-laden aspirations.
2. General definitions of biodiversity practices are always tentative, because the very act of defining them can lead to a modification of our theoretical and practical approaches to biodiversity theorizing and management.
3. In our contributions, we should all make it a rule to always define the global value-laden biodiversity practices into which we see our studies as being embedded, in such a way as to prevent, as far as possible, misunderstandings with other biodiversity studies or actions.
4. We should seize every opportunity to discuss and criticize the definitions put forward by the other biodiversity scientists who have followed the steps above.

Although they have never formally articulated it, art theoreticians and artists have historically followed a similar path, which proved to be very fruitful. Our hope is that biodiversity scientists can learn from this example.

Acknowledgements This work was supported by the Fondation pour la Recherche sur la Biodiversité. We wish to thank E. Casetta, D. Flynn, A. Krajewski, L. Lhoutellier, J. Marques da Silva, X. Morin and D. Vecchi for their comments and corrections.

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